



Case Report

Complete Abdominal Wall Disruption With Herniation Following Blunt Injury: Case Report and Review of the Literature

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Acute traumatic abdominal wall hernia (TAWH) is a rare type of hernia that occurs after a low- or high-velocity impact of the abdominal wall against a blunt object. With few cases reported, a consensus in diagnosis and management has not been established in the literature. A systematic review of the literature for adult cases of traumatic abdominal wall hernia due to blunt abdominal trauma was undertaken. All original articles were reviewed and data were compiled and tabulated qualitatively. Diagnostic imaging modalities and their reported description of the abdominal wall hernia were detailed correlated with the laparotomy findings. We also report a case of TAWH following blunt abdominal trauma, and describe integration of this management into clinical practice. Fifty-five cases of adult TAWH were found in the English literature. Most hernias contained either small bowel (69%) or large bowel (36%), with 16% of TAWH containing both. Concurrent intra-abdominal injuries were seen in 60% of cases, with an almost equal number of associated bowel (44%) and solid organ (35%) injuries. Twenty percent of diagnosis of TAWH was delayed, ranging from 2 days to 9 years. While TAWH is uncommon, a high index of suspicion is required in patients who present with blunt abdominal trauma. A staging system for TAWH can facilitate appropriate management

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priorities and treatment. CT scanning is crucial in the diagnosis of TAWH, and aids in definitive management of these patients. The literature supports immediate surgical exploration for most TAWH.

Key words: Abdomen – Computed tomography – CT – Trauma – Laparotomy

Acute traumatic abdominal wall hernia (TAWH) is a rare type of hernia that occurs after a low- or high-velocity impact of the abdominal wall against a blunt object. The first case was reported in 1906 and since then there has been a paucity of clinical reports.^{1,2} The incidence of acute post-traumatic hernia, which is rarely encountered in clinical practice, has been estimated at 0.07%.³ This is despite the high incidence of abdominal trauma as presentation to the emergency department.

Historically, there is a low threshold for urgent explorative laparotomy for the management of TAWH because of its strong association with intra-abdominal injury.⁴ However, with the increasing accuracy of modern computed tomography (CT) in diagnosing visceral injuries and increasing practice for conservative management of solid organs injuries, there is an argument towards managing TAWH conservatively. With few cases reported, a consensus in diagnosis and management has not been established in the literature.

In this study, we perform a thorough review of the literature and characterize all cases of TAWH. We also report our experience with a case of TAWH and discuss a clinical approach in light of the literature findings. Associations were made between diagnostic findings and grading of TAWH, with the need for urgent surgery.

Methods

A systematic review of the literature via a thorough MEDLINE search for adult cases of traumatic abdominal wall hernia due to blunt abdominal trauma was undertaken. All original articles were reviewed and data were compiled and tabulated qualitatively. The keywords search comprised “traumatic abdominal wall hernia” and “handlebar hernia,” and all linkage terms. Cases for inclusion were those 18 years and older, inclusive of all mechanism of injuries. Cases that comprised lumbar defects were excluded. Patient age, gender, and mechanism of injury were recorded. Clinical examination findings were classified as palpable hernia, when it was clearly stated in the article, otherwise

ecchymosis when clinical examinations were indeterminate. Grading of abdominal wall disruptions was according to Dennis *et al* (2009) numeric grading system (see Table 1). Diagnostic imaging modalities and their reported description of the abdominal wall hernia were detailed, correlated with the laparotomy findings.

We also report a case of TAWH following blunt abdominal trauma, and describe integration of this management into clinical practice.

Results

Fifty-five cases of adult traumatic abdominal wall hernia were found in the English literature. The characteristics of each of the cases are tabulated in Table 2. The data were collated and their incidences were presented in Table 3.

The incidence of TAWH was found to be most prevalent in the male population younger than 50 years of age. TAWH happened most frequently as a result of motor vehicle accidents (40%), either as a driver or passenger. Most TAWH presented as either ecchymosis (49%) or a localizing palpable hernia (31%). Locations of TAWH were somewhat equally distributed in all quadrants of the abdomen. The diagnostic imaging modality of choice was computed tomography (CT), which was used in 41 cases (75%). CT scan proved to be a very sensitive diagnostic tool for TAWH, with 90% of initial scan confirming the diagnosis. In 4 cases, only subsequent CT scans were diagnostic of TAWH, with initial earlier CTs not showing observable disruption in abdominal muscle wall. Ninety-six percent of cases reported in the literature had grade V abdominal wall disruption, with the rest presenting with grade IV abdominal wall disruption. Most of the hernia contained either small bowel (69%) or large bowel (36%), with 16% of TAWH containing both. Concurrent intra-abdominal injuries were seen in 60% of cases, with an almost equal number of associated bowel (44%) and solid organ (35%) injuries. Twenty percent of diagnosis of TAWH was delayed, ranging from 2 days to 9 years. Majority of TAWH management were by immediate

Table 1 Abdominal wall disruption grading system

Abdominal wall grade	Definition
I.	Subcutaneous tissue contusion
II.	AW muscle hematoma
III.	Single AW disruption
IV.	Complete AW disruption
V.	Complete AW disruption with abdominal content herniation
VI.	Complete AW disruption with evisceration

surgical repair in 42 cases (76%). Delayed hernia repair were performed in 8 cases (15%), while no repair was observed in 2 cases (4%), and 2 other cases did not report their method of abdominal wall repair.

Case Report

A 25-year-old muscular man presented to the emergency department at Sunshine Hospital immediately following blunt abdominal trauma; he had a motor bike accident at approximately 50 km/hour and as a result, he sustained an injury of his abdomen to the handlebar. A few minutes after the accident, a periumbilical bulge with surrounding ecchymosis was noticed at the point of impact, which thought to be large rectus sheath hematoma on initial assessment. The patient denied any previous abdominal wall hernia. He complained of diffuse abdominal pain. His primary survey was unremarkable. Abdominal examination revealed tender soft tissue bulge above the umbilicus with superficial ecchymosis measuring approximately 7 × 10 cm, which was thought to be a large rectus sheath hematoma. No other associated injuries were discovered on the rest of his secondary survey. CT abdomen demonstrated ventral abdominal hernia disrupting all the layers and contacting small bowel (Figs. 1 and 2). There were no other injuries seen. The patient was taken to theatre for explorative laparotomy. There were no intra-abdominal injuries detected. The hernia was reduced and he underwent early mesh tension-free repair. He remained well and was discharged after 3 days.

Discussion

The term “handlebar hernia” was initially introduced by Dimyan *et al* in 1980.⁴³ The mechanism of injury for TAWH usually involves a sudden application of a large force to a small area of the abdomen resulting in the disruption of the deeper tissue of the muscle and fascia with or without skin involve-

ment.¹⁹ The tangential shearing stresses associated with a sudden elevation in intra-abdominal pressure are thought to be the basic injury mechanism.⁴⁴ TAWH has been associated with delayed presentation with some postulated theory relating muscle spasm from pain following the trauma initially masking the defect. Ensuing muscle relaxation and raised intra-abdominal pressure from bowel dilatation then thought to exacerbate the muscular defect and developed the herniation. Delayed herniation, as a result of weakening of the abdominal wall from a hematoma or wound infection, have also been reported.³¹

The frequency of traumatic hernia is considered infrequent if compared with the presentation of blunt abdominal trauma in clinical practice. Dennis *et al*³ reported an incidence of 0.2% of 3932 CT scans performed after blunt trauma at a level 1 trauma center over a 20-month period. Several attempts have been made to classify traumatic abdominal wall hernia but Dennis *et al* developed an effective numeric grading system in 2009 (Table 1). Notably the grade 5 herniation (complete abdominal wall disruption with herniation of abdominal contents) for all blunt trauma patients has been estimated at 0.07%. In most reported cases, these cases were managed by early operative repair.

Early recognition and differentiation from hematoma is important and a high index of suspicion and awareness of the condition facilitates treatment and improves outcome. The differential diagnosis is mainly a rectus sheath hematoma and therefore, like others, we believe that high index of suspicion is essential as an accompanying hematoma often confounds the diagnosis.⁴⁵ CT scan is crucial in the diagnosis of traumatic hernias due to the frequent association with significant intra-abdominal injuries.⁴⁶ Old age, weak abdominal muscles, and pre-existing hernia are known risk factors for traumatic hernias.⁴⁷ However, our patient was of a young age, muscular with no pre-existing abdominal wall defect.

Table 2 Each of the reported cases of total abdominal wall hernia (TAWH) in the literature RUQ, right upper quadrant; RLQ, right lower quadrant; LUQ, left upper quadrant; LLQ, left lower quadrant; CT, computed tomography; MVA, motor vehicle accident; MCA, motor cycle accident; U/S, ultrasound; MRI, magnetic resonance imaging.

Age	Sex	Mechanism	Location	Clinical exam	Imaging modality
22	M	MCA handlebar trauma	RUQ	Palpable hernia	CT
56	M	MVA passenger	RLQ	Palpable hernia	CT
27	M	Sandwiched between rock and truck	RUQ	Palpable hernia	CT
59	M	Fall from 9 m, high-energy trauma	RLQ	Palpable hernia	CT
45	M	Penetrating injury by cow	RLQ	Palpable hernia	Ultrasound
45	M	Fall from height onto blunt object	RLQ	Ecchymosis	CT
60	F	Fall with blunt abdominal trauma	RLQ	Palpable hernia	CT
37	M	MCA	LUQ	Ecchymosis	CT
45	F	MVA restrained passenger	RUQ	Nonspecific	CT
61	M	Direct bicycle handlebar	RUQ	Palpable hernia	CT
29	M	Falling from 8 m construction site	RUQ	Palpable hernia	CT
43	M	MVA unrestrained passenger	RLQ	Ecchymosis	CT
40	F	Struck by bull horn	RLQ	Palpable hernia	N/A
38	M	MVA driver	LUQ	Ecchymosis	CT
59	M	Sandwiched between truck and bin	LLQ	Ecchymosis	CT
47	F	Pedestrian struck by truck	RUQ	Palpable hernia	CT
20	M	MVA	RUQ	Ecchymosis	CT and U/S
36	M	Struck bicycle handlebar	LLQ	Ecchymosis	CT
64	M	Penetrating bull horn	LLQ	Penetrating wound	N/A
44	M	Fall from height 3m	LLQ	Ecchymosis	CT
55	M	MVA restrained passenger	RUQ	Ecchymosis	CT
20	M	Struck motorcycle handlebar	LUQ	Palpable hernia	CT
65	F	Blunt trauma from collapsed roof	LLQ	Palpable hernia	Nil
25	M	Hit by bus	LUQ	Ecchymosis	CT
30	M	MCA	LUQ	Ecchymosis	CT
36	F	Struck by automobile	RLQ	Nonspecific	CT
34	F	MVA passenger	LUQ	Nonspecific	CT
27	M	MVA restrained passenger	LLQ	Ecchymosis	CT
35	F	MVA restrained passenger	LLQ	Ecchymosis	CT
22	M	MVA ejected unrestrained driver	RLQ and LUQ	Non-specific	CT
19	M	MVA	LLQ	Ecchymosis	CT
38	F	MVA restrained driver	RLQ	Ecchymosis	CT
37	F	MVA unrestrained driver	RLQ	N/A	CT, U/S and MRI
47	M	Wooden axe handle	RLQ	Palpable hernia	U/S
24	M	Struck by metal cylinder of an industrial machine	LLQ	Ecchymosis	U/S and CT
18	M	MCA motorcycle handlebar	LLQ	Palpable hernia	CT
25	M	Run over by truck	RLQ	Nonspecific	CT
63	F	MVA restrained passenger	LLQ	Nonspecific	Peritoneal tap
22	M	MCA	LLQ	Ecchymosis	CT
72	F	MVA restrained rear passenger	LLQ	Nonspecific	CT
24	M	MCA	RLQ	Nonspecific	CT
23	M	MVA unrestrained driver	LLQ	Ecchymosis	CT
22	M	MCA	LUQ	Ecchymosis	CT
20	M	MVA restrained driver	LLQ	Ecchymosis	CT
70	F	MVA restrained rear passenger	RUQ	Ecchymosis	CT
N/A	F	MVA restrained passenger	RUQ	Ecchymosis	CT
46	M	MVA	RLQ	Ecchymosis	CT
22	M	MCA handlebar trauma	LUQ	Ecchymosis	Peritoneal lavage
24	M	MVA	RLQ	Palpable hernia	X-ray
19	M	Sandwiched between truck and wall	RLQ	Non-specific	Peritoneal lavage
42	M	MVA unrestrained passenger	RUQ	Palpable hernia	X-ray
45	M	MCA	LUQ	Ecchymosis	Peritoneal lavage
38	M	Pickaxe handle trauma	RLQ	Palpable hernia	X-ray
49	M	Snowmobile handlebar trauma	RUQ	Ecchymosis	Barium radiograph
46	M	Fell 25 feet	RUQ	Ecchymosis	X-ray

Table 2 Extended

Hernia content	Injury grade	Intra-abdominal injury
Small bowel	V	No
Small bowel	V	Ischemic small bowel
Transverse colon	V	Lacerated intestine and pancreas
Small bowel, ascending colon and Right Lobe of liver	V	Ischemic bowel, mesentery and splenic hemorrhage
Ileum	V	No
Small bowel	V	Ileal perforation
Ascending colon and small bowel	V	No
Sigmoid colon	V	Strangulated sigmoid colon, spleen rupture, ileum ischemia
Small bowel	V	Small bowel contusion
Small bowel	V	No
Ascending colon hernia	V	Ischemic colon, liver laceration
Small bowel	V	Gangrenous small bowel
Small bowel	V	No
Small bowel	V	Ischemic bowel, Mesenteric hematoma, splenic laceration
Small bowel and sigmoid colon.	V	Gangrenous sigmoid
Right colon and small bowel	V	Liver and spleen laceration
Hepatic parenchyma	V	Liver laceration
Small bowel	V	No
Small bowel	V	No
Left colon	V	No
Small bowel	V	Aortic rupture, strangulated colon
Small bowel	V	Jejunal perforation
Small bowel and sigmoid colon	V	No
Small bowel	V	No
Small bowel	V	No
Colon	V	Liver and splenic laceration
Small bowel	V	Contused liver, duodenum perforation, bladder and gall bladder rupture
Sigmoid colon hernia	V	Ischemic sigmoid
Small bowel	V	No
N/A	IV	Stomach rupture, liver and splenic laceration
N/A	IV	Avulsion of ileum, omentum, cecal rupture, renal contusion
Caecum	V	No
Colon	V	Liver and spleen contusions, traumatic rupture of bladder
Small bowel	V	No
Small bowel and sigmoid colon herniation	V	Splenic laceration, Laceration of colon and necrotic sigmoid
Sigmoid colon	V	Scrotal laceration
Small bowel	V	No
Small bowel	V	Ruptured ileum
Small bowel	V	Liver laceration
Colon	V	No
Retroperitoneal fat	V	Right kidney fracture
Small bowel and transverse colon	V	Ischemic jejunum
Small bowel	V	No
Small bowel	V	Ischemic jejunum and sigmoid colon
Small bowel	V	Ischemic bowel, and ruptured right hemidiaphragm
Small bowel	V	No
Small bowel	V	Kidney and spleen laceration
Transverse colon and jejunum	V	Serosal tear on colon
Small bowel, cecum, and ascending colon	V	Ischemic bowel
Small bowel	V	Ischemic bowel
Small bowel	V	No
Splenic flexure of colon and mesocolon	V	No
Small bowel	V	No
Small bowel	V	No
Small bowel	V	Liver laceration

Table 2 Extended

Delayed diagnosis	Initial management	Abdominal wall repair	Author
No	Laparotomy	Immediate closure	Kuo 2012 ⁵
No	Bowel resection	Immediate layered closure	Hassan 2012 ⁶
No	Right hemicolectomy, pancreatoduodenectomy	Immediate layered closure	Ajisaka 2011 ⁷
No	Bowel resection	Immediate mesh repair	Den Hartog 2011 ⁸
No	Laparotomy	Immediate layered closure	Singal 2011 ⁹
No	Bowel resection	Immediate layered closure	Singal 2011 ⁹
No	Laparotomy	Immediate mesh repair	Singal 2011 ⁹
Delayed - 7 days	Left hemicolectomy, splenectomy, left nephrectomy	Vacuum assisted closure, with delayed layered closure	Benini 2011 ¹⁰
No	Bowel resection	Immediate biological matrix closure	Mooty 2010 ¹¹
No	Observation	Delayed mesh repair (6 weeks)	Henrotay 2010 ²
No	Right hemicolectomy	Immediate layered closure	Yucel 2010 ¹²
Delayed - 3 days	Bowel resection	Immediate mesh repair	Sall 2009 ¹³
No	Laparotomy	Immediate mesh repair	Agarwal 2008 ¹⁴
No	Bowel resection	Immediate layered closure	Agarwal 2008 ¹⁴
Delayed - 4 days	Left hemicolectomy	Immediate layered closure	Tan 2007 ¹⁵
No	Laparotomy	Immediate layered closure	Choi 2007 ¹⁶
No	Conservative management	Delayed mesh repair (3 months)	Talwar 2007 ¹⁷
No	Laparotomy	N/A	Okamoto 2007 ¹⁸
Delayed 4 months	Delayed diagnosis	Delayed mesh Repair	Belgers 2005 ¹⁹
Delayed 9 years	Delayed diagnosis	Delayed mesh Repair	Belgers 2005 ¹⁹
No	Aortic repair, right hemicolectomy	Immediate mesh repair	Mahajna 2004 ²⁰
No	Laparotomy	Immediate layered closure	Huang 2004 ²¹
No	Laparotomy	Immediate fascia lata graft closure	Singh 2004 ²²
No	Laparotomy	Immediate layered closure	Kumar 2004 ²³
No	Laparotomy	Immediate layered closure	Kumar 2004 ²³
No	Bowel repair, splenectomy	Immediate layered closure	Lane 2003 ²⁴
No	Laparotomy bowel anastomosis	Immediate layered closure	Lane 2003 ²⁴
No	Laparotomy bowel resection	Immediate layered closure	Lane 2003 ²⁴
No	Laparotomy	Immediate layered closure	Lane 2003 ²⁴
No	Laparotomy	Immediate layered closure	Lane 2003 ²⁴
No	Laparotomy bowel resection	Immediate layered closure	Lane 2003 ²⁴
No	Laparotomy	Immediate mesh repair	Munshi 2002 ²⁵
Delayed 3 months	Delayed diagnosis	Delayed mesh repair	Borens 2002 ²⁶
No	Hernia repair	Immediate layered closure	Losanoff 2002 ²⁷
Delayed 4 days	Laparotomy, bowel resection	Immediate layered closure	Walcher 2000 ²⁸
No	Laparotomy	Immediate layered closure	Shiomi 1999 ²⁹
No	Hernia repair	Immediate mesh repair	Drago 1999 ³⁰
No	Laparotomy	Immediate layered closure	Damschen 1994 ³¹
No	Hernia repair	Immediate layered closure	Damschen 1994 ³¹
No	Observation	Conservative management	Damschen 1994 ³¹
No	Observation	No follow-up	Damschen 1994 ³¹
No	Laparotomy, bowel resection	Immediate layered closure	Gill 1993 ³²
Delayed 2 days	Laparotomy	Immediate layered closure	Sahdev 1992 ³³
No	Laparotomy, bowel resection	Immediate layered closure	Sahdev 1992 ³³
No	Laparotomy, bowel resection	N/A	Low 1990 ³⁴
Delayed 3 years	Delayed diagnosis	Delayed layered closure	Taylor 1989 ³⁵
No	Laparotomy	Immediate layered closure	Jones 1989 ³⁶
No	Laparotomy	Immediate layered closure	Rao 1987 ³⁷
No	Laparotomy, bowel resection	Left open	Fullerton 1984 ³⁸
No	Laparotomy, bowel resection	Immediate layered closure	Fullerton 1984 ³⁸
No	Laparotomy	Immediate layered closure	Malangoni 1983 ³⁹
Delayed 10 days	Delayed laparotomy (45 th day)	Immediate layered closure	Guly 1983 ⁴⁰
No	Laparotomy	Immediate layered closure	Guly 1983 ⁴⁰
Delayed 2 days	Delayed laparotomy (12 th day)	Delayed layered closure	Dubois 1981 ⁴¹
No	Laparotomy	Immediate layered closure	Dajee 1979 ⁴²

Table 3 Summary of all traumatic abdominal wall hernias (TAWH) reported in the literature

Characteristics	Number (%)
Cases	55
Age - median (years)	37.5 (1872)
Female	14 (25)
Male	41 (75)
Mechanism of injury	
Motor vehicle accident (MVA)	22 (40)
Motorcycle handlebar	9 (16)
Bull horns	3 (5)
Falls	6 (11)
Other blunt trauma	15 (27)
Clinical examination findings	
Palpable hernia	17 (31)
Ecchymosis	27 (49)
Nonspecific	9 (16)
Penetrating wound	1 (2)
Not available	1 (2)
Location of TAWH	
Right upper quadrant	13 (24)
Right lower quadrant	18 (33)
Left upper quadrant	9 (16)
Left lower quadrant	15 (27)
Hernia contents	
Small bowel	38 (69)
Large bowel	20 (36)
Solid viscera	1 (2)
Abdominal wall disruption grade	
grade IV	2 (4)
grade V	53 (96)
Concurrent intra-abdominal injuries	33 (60)
bowel injury	24 (44)
solid organ injury	19 (35)
Delay in diagnosis	11 (20)
Surgical management	
Layered closure	34 (62)
Mesh repair	12 (22)
Other closure	2 (4)
No surgical treatment	7 (13)

Treatment has been controversial and both mesh and primary repair have been successfully performed for treatment of traumatic hernia.²⁴ Traditional layered suture repair has a high recurrence rate, with previous studies measuring up to 54% for incisional hernia repair.^{30,48,49} Mesh repair has a comparatively lower recurrence rate between 15–30%.^{48,49} Delay in hernia repair has only been reserved for unstable patients with immediate risk to their lives.³⁷ These studies collectively advocate immediate surgical exploration and repair to avoid complications such as incarceration and strangulation, with no studies offering any reasons otherwise.^{30,46} Of note, this evidence is largely based on case series, with no level 1 or 2 studies undertaken in such cases.



Fig. 1 Axial computed tomography (CT) slice demonstrating abdominal wall disruption of all layers. There is loss of continuity between rectus abdominus muscles, with protrusion of small bowel into the subcutaneous space. No other intra-abdominal injury or free fluid is seen in the abdominal cavity.

Conclusion

While TAWH is uncommon, a high index of suspicion is required in patients who present with



Fig. 2 Sagittal computed tomography (CT) slice demonstrating protrusion of abdominal contents through a disruption of all layers of the abdominal wall.

blunt abdominal trauma. A staging system for TAWH can facilitate appropriate management of priorities and treatment. CT scanning is crucial in the diagnosis of TAWH, and aids in definitive management of these patients. The literature supports immediate surgical exploration for most TAWH.

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